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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/065,296	10/01/2002	Liang-Hua Lin	NAUP0477USA	5720
27765	7590	10/28/2005	EXAMINER	
NORTH AMERICA INTELLECTUAL PROPERTY CORPORATION P.O. BOX 506 MERRIFIELD, VA 22116			NGUYEN, TUAN H	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 10/28/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/065,296

Applicant(s)

LIN ET AL.

Examiner

Tuan H. Nguyen

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 August 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 and 20-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 20-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-10, 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pan'553 (cited ref.) in view of Chien et al..

Pan'553, figs. 2-7 and related text on col. 3-5 discloses substantially the claimed method for forming a photo sensor on a p-type substrate and an insulating layer 38 positioned on the surface of the substrate and surrounding the photo sensor 40 (fig. 7) including the step of performing a first implantation process utilizing N-type dopants to form the plurality of first doped regions 44 through a first mask (not shown, note also on col. 3, lines 58-65 for the necessity of masks in ion implantation) for increasing a contacting area between each first doped region and the substrate so as to increase a sensing area of the photo sensor 40 (col. 5, lines 1-5, fig. 7); removing the first mask, and performing a second ion implantation process utilizing N-type dopants through a second mask (not shown) to form a second doped region 42 on the surface of the photo sensor 40 covering the surface of the substrate between two adjacent first doped regions 44 (col. 4, third and fourth paragraphs, fig. 7).

Note also in fourth paragraph, Pan'533 suggests the order of forming regions 42 and 44 could also be exchanged.

With respect to claim 2, fig. 2 shows first doped region 44 and second doped region 42 interact with neighboring substrate 32 to form a plurality of depletion regions.

With respect to claims 3, 4, Pan'533, col. 3, line 29-44 discloses the use of either P-type or N-type dopants as first type and second type dopants.

With respect to claim 6, see col. 4, lines 29-41 for the dopant density of region 44 that is less than that of region 42.

With respect to claim 7, 21, Pan'533, col. 4, lines 41-47 suggests that the MOS transistor 36 and sensor 40 could be formed together simultaneously.

With respect to claim 8, the annealing is inherently performed in order to activate the dopants which is well-known to those skilled in the art.

With respect to claim 9, since Pan'553, as explained above, discloses the method for increasing in depletion region (see also col. 5, first and second paragraphs) as in the instant claimed invention wherein each of the depletion regions formed between the neighboring first doped regions is inherently a complete depletion region, and a capacitance of each of the depletion regions is approximately equal zero for increasing a sensing area, decreasing dark current, and further increasing photo current and photon conversion gain.

With respect to claim 10, since the second doped region 42 formed on the surface of the sensor region is a conductive region, and would be inherently used as a conductive wire for the photo sensor.

With respect to claim 20, Pan'533 discloses the method of claim 1 wherein the first mask and the second mask layer further define positions for forming a plurality of depletion regions in the photo sensor, each of the depletion regions being located under the second doped region 42, between the two adjacent first doped region 44, and extending under the two adjacent first doped regions 44 as shown in fig. 2.

Pan'533 lacks anticipation of forming the second doped region covering a top surface of each of the first doped region.

Chien et al., in a related art as shown in figs. 2A-2E and text on col. 3-4, teaches the use of mask 212 for forming plurality of doped region 216 deep in the substrate (fig. 2C and text on col. 3, next to last paragraph), and shallow region 208 on the surface of photo sensor region covering a top surface of each of the doped region 216 and the surface of the substrate between any two adjacent doped region 216 (fig. 2E). Note in fig. 2A, shallow region 208 also forms lightly doped region for MOS device simultaneously; and col. 2, lines 43-48 suggests the source/drain region could be formed either before or after the sensor region.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have formed the second doped region covering top surface of each of the first doped regions and simultaneously forming sensor region and MOS lightly doped region as taught from Chien et al. in Pan'533 process of forming a sensor since it would reduce the process steps, time and cost by simultaneously forming the devices at the same time, and increase sensing area, decrease dark current and

improve the device performance by forming multiple deep region of at least three, and cover them with a shallow region.

It would have been also obvious to those skilled in the art to form the sensor in an epitaxial silicon layer which is currently well-known in semiconductor processing technology for reducing the thickness of the device as compared to the device formed in the bulk silicon substrate.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Wolffenbuttel, and Kuroda teach the formation of second doped region covering top surface of the first doped regions in photo sensor process.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

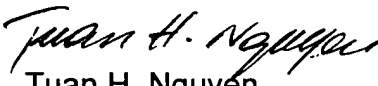
Response to Arguments

Applicant's arguments with respect to claims 1-10, 20-22 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan H. Nguyen whose telephone number is 571-272-1694. The examiner can normally be reached on 9AM-5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Tuan H. Nguyen
Primary Examiner
Art Unit 2813